Ice fossils found in meteorite

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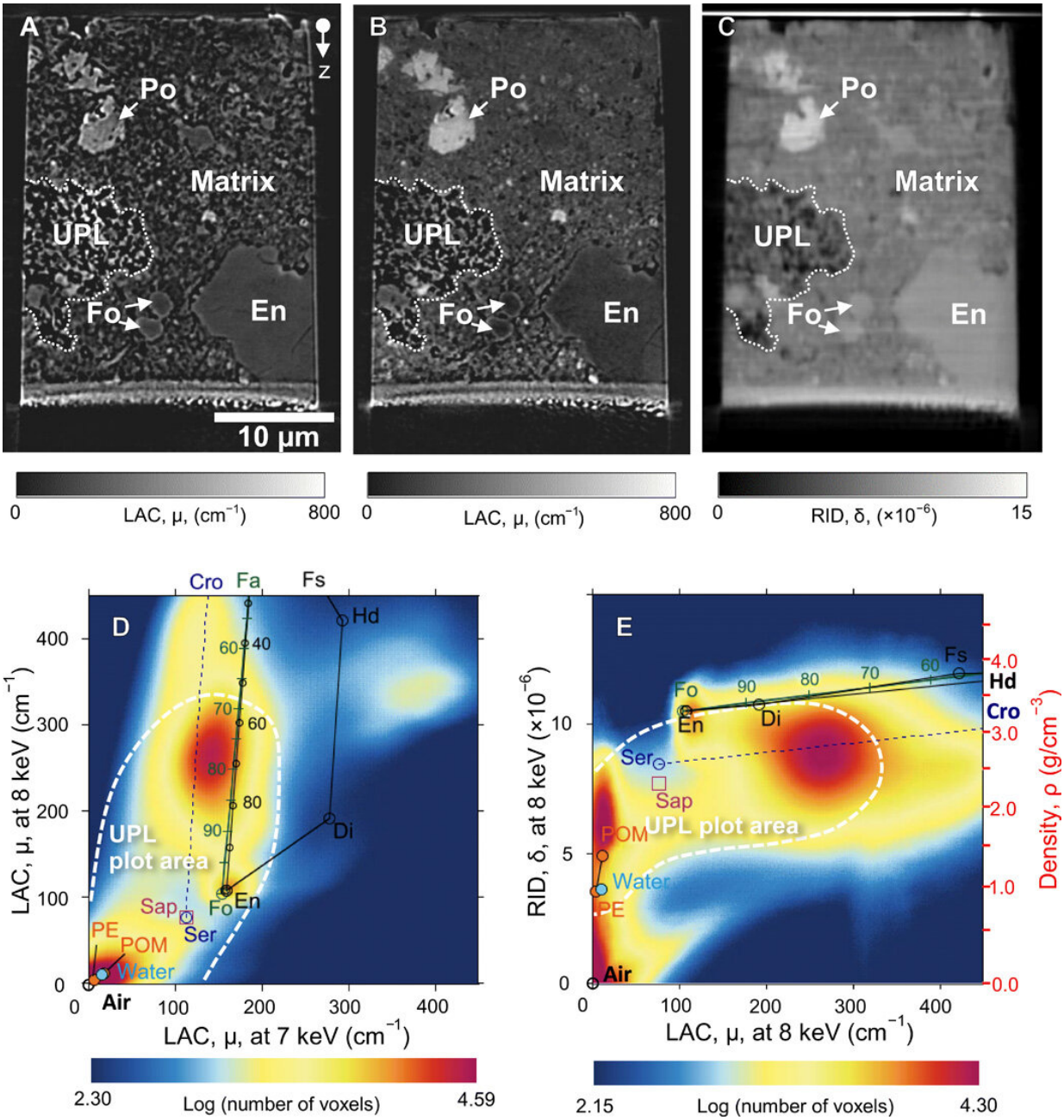

XCT slice images of equant samples of the Acfer 094 matrix and their 2D histograms of LAC and RID values at 7 and 8 keV. Absorption XCT images at 7 keV (A) and 8 keV (B), as well as a phase XCT image at 8 keV (C), indicate an UPL embedded in the matrix. 2D histograms of LAC values at 7 and 8 keV (D) and LAC and RID values at 8 keV (E) of the matrix show peaks around the air, resin [polyacetal (POM)], forsterite (Fo), enstatite (En), and serpentine/saponite (Serp/Sap)–cronstedtite (Cro). Those plots of UPL have peaks in the areas surrounded by white dashed lines in (D) and (E). The density scale corresponding to the RID values is shown in (E). Fa, fayalite; Di, diopside; Hd, hedenbergite; Fs, ferrosilite; Po, pyrrhotite; PE, polyethylene. Credit: *Science Advances* (2019). DOI: 10.1126/sciadv.aax5078

A team of researchers from Japan, China and the U.K. has found evidence of ice fossils on the surface of a meteorite. In their paper published in the journal *Science Advances*, the group describes their close-up study of the Acfer 094 meteorite and what they found.

The Acfer 094 meteorite was found in the Algerian mountains back in 1990—since that time, it has undergone intense scrutiny due to its age—it has been dated back to approximately 4.6 billion years ago, which makes it a primitive meteorite. The 82-gram meteorite is believed to harbor evidence of the primitive solar system and may therefore be able to provide scientists with clues about how planets and other celestial bodies formed.

In this new effort, the researchers studied the meteorite using synchrotron radiation-based X-ray computed nanotomography. In so doing, they found evidence of extremely tiny pores of 10 microns across. They believe the pores are fossilized ice crystals—or more correctly, tiny indentations on the surface of the meteorite that once contained ice crystals. They suggest the pores were left behind when the meteorite crossed the snow line—a virtual sphere surrounding the sun that marks

the boundary where heat from the sun melts ice on meteorites.

The researchers report that they also found evidence of mineral formation in the pores—the result of interactions between water and materials in the rock that make up the meteorite. But posed even more questions—the researchers note that there could not have been enough water in the pores to produce the amounts of minerals they found. There had to have been more ice. They suggest this is a sign that the parent body (they believe the meteorite was once part of a larger object) was heterogeneous. They further suggest that as the parent body crossed the snow line, surface ice would have melted and dissipated. And this would have resulted in higher water or ice content in the core than the outer layers. Such a finding is important, they claim, because it could lead to a better understanding of how the water here on Earth arrived. Their findings suggest it had to have come from farther out in the solar system than has been thought.

More information: Megumi Matsumoto et al. Discovery of fossil asteroidal ice in primitive meteorite Acfer 094, *Science Advances* (2019). DOI: 10.1126/sciadv.aax5078